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ORIGINAL ARTICLE

Impact of health policy based on the self-management program on Cesarean section rate at a tertiary hospital in Taiwan

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KEYWORDS
Cesarean section rate;
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Poisson regression model

Background/Purpose: In 2005, a self-management program, based on the global budget system that met the criteria for reducing Cesarean delivery rates, was introduced to obstetric practices in Taiwan. The purpose of this study was to examine the impact of different national health policies on the Cesarean delivery rate at a tertiary hospital.

Methods: We constructed a Poisson regression model and conducted an interrupted time series analysis to detect the effects of the implementation of each health policy on Cesarean deliveries. We used data collected at two points before the implementation of the global budget system (GBS) policy (in 2001 and 2002), and at two points after the implementation of the hospital-based self-management (HBSM) policy (in 2005 and 2010). All monthly data were collected at these time points.

Results: Between June 2001 and August 2010, the rate of improvement of vaginal birth after Cesarean section (VBAC) during Period 1 revealed that VBAC may have long-term effects ($p < 0.001$). While there may have been a remarkable immediate improvement in the VBAC rate ($p = 0.0276$) in Period 3, the long-term effect of VBAC seemed to have decreased during the same period ($p = 0.0003$). Following the synergistic impacts of health policy implementation during Period 3, the immediate improved total Cesarean section (C/S) rate seemed to be maintained at an average value ($p = 0.0183$).

Conclusion: Over the long term, the C/S rate seemed to reach a plateau; the immediate effect on the VBAC rate was a significant increase consistent with that of the initial health policy implementation.

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Introduction

The concern about and interest in Cesarean sections (C/S) with regard to health care quality are relatively recent developments in Taiwan.[1] In fact, it is a concern that has become particularly important in many countries.[2,3,4] The C/S rate could be influenced by many factors, including maternal demographic factors, decision making by obstetricians, prenatal care factors, intrapartum and postpartum factors, as well as patient choices. Evidence from previous studies suggests that Cesarean delivery may increase the occurrence of severe maternal and perinatal morbidities.[5,6,7] Accordingly, a reduced C/S rate has become an indicator of quality health care in many developed countries.[8,9,10] National health policies may influence the results of the measurements of such indicators.

The Taiwan National Health Insurance Program was implemented in 1995 to provide fee-for-service health care on a population basis, and it was expanded in 2002 to provide hospital services under the global budgeting design.[11]

The escalating costs of health care, which were implemented as the result of a growing aging population, the development of new technology, and 100% national health insurance plan coverage, caused a deficit in the country's annual budget. The global fee-for-service payment system, which covers thousands of hospitals and primary care physician practices, each billing against a budget, poses significant utilization management challenges for the profession.[12,13,14]

The term "global budget system" refers to direct and complete government funding of hospitals on a prospective basis. This system tends to result in resource allocation and cost control, including cost containment, funding certainty, easier and cheaper administration, improved coordination and planning of services, and the elimination of unnecessary services.[15] Each hospital in Taiwan has "global funding" distributed by the Bureau of National Health Insurance and the steering committee of the Taiwan Medical Association. The definition of the "hospital-based self-management program" is based on the hospital global budget system, which for our purposes, refers to a strategy employing postoperative peer reviews and audits to reduce medical service costs incurred by C/S.

The fee-for-service incentive and various management problems pose serious obstacles for the reduction of C/S rates.

Literature and data concerning the physician's perspective on the Cesarean delivery rate in Taiwan are currently insufficient. Furthermore, C/S rate trend analysis is lacking in that an effective strategy for auditing and monitoring physicians' decision-making behavior and results is unavailable. The purpose of this study was to examine the influence of the global budget strategy under the National Health Insurance system and to conduct retrospective peer review evaluations and physician self-regulation management interventions for C/S rates and other performance indicators at a tertiary hospital in Taiwan.

We recognized and assumed that general practitioners and obstetricians are likely to perform C/S owing to revenue-based and fee-for-service practices.[8] Reimbursement and compensation for a C/S is greater than that for a normal spontaneous vaginal delivery (NSD). It also must be noted that some patients may request C/S because of cultural or personal issues. Elective C/S may be paid for in part by the patient, out-of-pocket.

We then hypothesized that the impact of the national health policy of the global budget system and the hospital-based self-management strategy could reduce the total C/S rate in a tertiary hospital.

Patients and methods

This study was approved by the Institutional Review Board of Chang Gung Memorial Hospital in Tao-Yuan, Taiwan (No. 98-1049B).

We assessed all pregnant women who delivered babies by Cesarean section between June 2001 and August 2010 at Chang Gung Memorial Hospital in Linkou, Taiwan. The hospital global budget system (GBS) was implemented in July 2002 with the support of the health policy and with regard to the Taiwan Quality Indicators Project (TQIP). Similarly, the hospital-based self-management (HBSM) and physician self-disciplinary management programs were implemented in August 2005. Concurrently, peer review evaluation had been conducted on the C/S rate in tertiary hospitals.

C/S rates were analyzed before and after the initiation of the GBS and HBSM policies and the results of these analyses were compared. Delivery methods by surgical intervention included C/S, vaginal birth after Cesarean section (VBAC), primary C/S (PCSR), and repeated C/S (RCSR). The study was conducted over three periods: Period 1 refers to the period preceding the implementation of the GBS in 2002; Period 2 refers to the time between the implementation of the GBS and HBSM in 2005; and Period 3 refers to the period encompassing physician self-disciplinary management.

We used descriptive characteristics and selective performance indicators of obstetrics care to audit whether the outcome measures fulfilled certain criteria of health care quality, and then employed two statistical approaches, Poisson regression and interruptive time series analysis. Poisson regression was used to compare the monthly C/S rates in Period 3 with the corresponding monthly C/S rates in Periods 1 and 2. The outcome measurement of Poisson regression was demonstrated as a dependent variable. Calculations were presented as the log of the ratio of observed to expected C/S rates. We used interrupted time series analyses to test the effects of the different health policy implementations on C/S rates.[16] Two regression models were used to estimate the trends of the C/S rates in the different study periods. We conducted a nonparametric analysis to evaluate the observed distribution of the monthly C/S rates among different perspectives using Poisson regression and interrupted time series analyses. The Friedman test was used in a three-phased time interval and the Wilcoxon signed rank test was used to test the significance of the mean values among three different phases. All p values were two sided and

Table 1 C/S rate during period 1 (NHIS before GBS), period 2 (after GBS but before HBSM), and period 3 (after GBS and HBSM).

Characteristics	Period 1	Period 2	Period 3
	n (%)	*n* (%)	*n* (%)
C/S rate	1751/4988 (35.10)	4286/11680 (36.70)	6794/18948 (35.86)
Primary C/S	989/4188 (23.62)	2630/9793 (26.86)	4471/16327 (26.87)
Repeated C/S	762/800 (95.3)	1656/1887 (87.76)	2323/2621 (88.63)
VBAC Rate	38/800 (4.75)	231/1887 (12.24)	298/2621 (11.37)

C/S rate = total C/S rate [HBSM on August, 2005]; NHIS National Health Insurance System; HBSM = Hospital-based self-management.

a p value of less than 0.05 was used to indicate statistical significance. The time series analysis helps the researcher identify changes in the level and slope of the series that occurs as a result of the different health policy interventions, with the goal being to estimate the treatment's effect on the basic regression discontinuity design.

We used the following equation to test the effect of the introduction of the directory assistance:

$$Y = b_0 + b_1T + b_2Z + e$$

where Y is the outcome variable, T is the time (by month) of change, b_1 is the slope of the regression equation, b_2 is the treatment effect (the change in the level of the series at the point of intervention), and Z is the intervention effect.

Similarly, with regard to Poisson regression, we evaluated the effect of the rate ratio among the different time periods after policy implementation.

Results

We analyzed 35,616 deliveries (mean 321 per month), including 12,831 C/S deliveries (mean 116 per month), with a mean total C/S rate of 36.03%. The mean value of PCSR was 26.7%; RCSR was 89.3%, and the successful VBAC rate was 10.68% per month between June 2001 and August 2010. The C/S rates before and after the implementation of the GBS were 35.1% and 36.18%, respectively. The C/S rate after the implementation of the HBSM was 35.86%. In addition, the RCSR rates before and after GBS were 95.3% and 88.27%, respectively, and 88.63% after the implementation of the HBSM.

An interrupted time series analysis was conducted for VBAC rates, as shown in Tables 1 and 2. Table 3 presents the trending of the long-term effects (slope) and immediate changes (level) of health policy implementation in the different categories of Cesarean deliveries. Table 4 presents the long-term effects on the rate of improvement of VBAC from Period 1 [rate ratio (RR), 1.2206; 95% confidence interval (CI), 1.1133-1.3498, $p < 0.001$]. This effect persisted in Period 2, but it seemed to reach a plateau (RR, 0.8238; 95% CI, 0.7444–0.9038, $p = 0.0001$). The immediate effect seen in Period 3, following policy implementations, reveals a remarkable improvement in the VBAC rate (RR, 1.4378; 95% CI, 1.0432–1.9919, $p = 0.0276$). However, the long-term effect of improvements in the VBAC rate ratio seemed to decrease during Period 3 (RR, 0.9755, 95% CI, 0.9624–0.9888, $p = 0.0003$). The Poisson regression model analysis revealed that the trend (level and improvement of change in terms of the rate ratio) of the different patterns of Cesarean delivery during the three periods was consistent with the results of the interrupted time series and segmented regression analysis shown in Fig. 1. The synergistic effects of health policy implementation during Period 3 resulted in an immediate effect of improvement on the total C/S rate, which seemed to hold to an average value (RR, 0.9109; 95% CI, 0.8430–0.9845, $p = 0.0183$). The long-term effect of improvement on the total C/S rate will be disputable, but it will not reach statistical significance (RR, 1.0001, 95% CI, 0.9970–1.0032, $p = 0.9471$) (Fig. 2).

Discussion

Our major findings indicate that total Cesarean rates may not decrease significantly following the implementation of a national health policy. VBAC was affected significantly at the beginning because of incentive mechanisms such as policy implementation and encouragement, in which reimbursement of VBAC costs would be equivalent to Cesarean delivery, but it reached a plateau because of the potential risk of uterine rupture.[5] However, a majority of C/S deliveries would eventually result in RCSR.

Few studies have dealt with the direct impact of health policy on the C/S rates in Taiwan. In its annual report in 1996, The Taiwan Society of Perinatology recorded a total C/S rate of 35.0%, including 59.3% PCSR and 40.7% RCSR

Table 2 C/S rate during period 1 (before GBS), period 2 (after GBS but before HBSM), and period 3 (after GBS and HBSM).

Characteristics	Period 1	Period 2	Period 3	Period 1 vs. 2	2 vs. 3
	n (%)	*n* (%)	*n* (%)	*p*	*p*
Total C/S Rate	1751(35.10)	4286 (36.70)	6794 (35.86)	0.0525	0.1409
Primary C/S	989 (23.62)	2630 (26.86)	4471 (27.38)	<0.001	0.3605
Repeated C/S	762 (95.25)	1656 (87.76)	2323 (88.63)	<0.001	0.3950
VBAC	38 (4.75)	231 (12.24)	298 (11.37)	<0.001	0.3950

Note: Using χ^2 or Chi-square analysis; VBAC = vaginal birth after Cesarean section.

Table 3 The trend (slope) and immediate change (level) after health policy implementation (intervention) in different categories of Cesarean delivery.

	Periods 1—2 (June, 2001—July 2005)		Periods 2—3 (August 2005—August 2010)	
TCS	Level (1.577)	*p* (0.399)	Level (-3.462)	*p* (0.003)
	Slope (0.142)	*p* (0.534)	Slope (0.001)	*p* (0.991)
PCS	Level (1.206)	*p* (0.487)	Level (-2.493)	*p* (0.030)
	Slope (0.018)	*p* (0.930)	Slope (-0.061)	*p* (0.196)
RCS	Level (-0.640)	*p* (0.804)	Level (-5.246)	*p* (0.006)
	Slope (0.862)	*p* (0.008)	Slope (0.272)	*p* (0.001)
VBAC	Level (0.641)	*p* (0.803)	Level (5.244)	*p* (0.006)
	Slope (-0.862)	*p* (0.008)	Slope (-0.272)	*p* (0.001)

All results were computed from interrupted time series and segmental regression analyses.
TCS = total Cesarean sections; PCS = primary Cesarean section; RCS = repeated Cesarean section; VBAC = vaginal birth after Cesarean section. *p* = p value.

from 1991 to 1995 in the nine teaching hospitals observed.[1]This highlights the trend of a high percentage of Cesarean delivery rates prior to universal coverage. Several other studies conducted in Taiwan in the last decade have dealt with the C/S rate. Lin (2004) stated that the C/S delivery profile showed a significantly lower clinical threshold for triggering C/S decisions in Taiwan, especially in OB-GYN clinics.[17] Wen (2008) found that National Health Insurance (NHI) implementation in Taiwan might achieve the goals of accelerated health improvement and health care disparity reduction. However, these studies did not mention health improvement initiatives that could enhance the quality of obstetric care measured by C/S rates.[18] Liu (2007) indicated that gender preference could increase the C/S rate; the rate slightly increased to 33.68% after NHI implementation, climbing to 34.47% by 2000.[19] In terms of financial incentives, our VBAC rates started at 4.8%, increased to 12.2%, and then reached a plateau, gradually decreasing later on. This is similar to the trend shown by Lo (2008) in which the VBAC fee rose in April 2003, from 3.5% to 4.8% in 2004, and to 4.9% in 2005.[8] The fee equivalence policy of VBAC was raised to the level of Cesarean delivery and implemented in May 2005, but it was not very impactful.

Table 4 Poisson regression analyses of Cesarean delivery rates adjusted Cesarean delivery rate ratio (95% CI).

Obstetric care	2001: Period before HGBS — Rate of Improvement in Period 1		July 2002—August 2005 (compare to 2001) — Change of Level from Period 1 to Period 2	
	95% CI	*p*	95% CI	*p*
Total C/S	0.9965 (0.9841—1.0091)	0.5826	1.0425 (0.9362—1.1621)	0.4501
Primary C/S	1.0025 (0.9858—1.0194)	0.7739	1.0467 (0.9091—1.2073)	0.5286
Repeated C/S	0.9908 (0.9724—1.0095)	0.3348	0.9891 (0.8394—1.1686)	0.8971
VBAC	1.2206 (1.1133—1.3498)	<0.001	0.9009 (0.5414—1.5575)	0.6978
	July 2002—August 2005 (compare to 2001*) — Change of Rate from Period 1 to Period 2		August 2005—2010 (compare to 2002*) — Chang of Level from Period 2 to Period 3	
	95% CI	*p*	95% CI	*p*
Total C/S	1.0049 (0.9920—1.0179)	0.4592	0.9109 (0.8430—0.9845)	0.0183
Primary C/S	1.0012 (0.9843—1.0185)	0.8874	0.9126 (0.8284—1.0058)	0.0646
Repeated C/S	1.0085 (0.9893—1.0281)	0.3892	0.9498 (0.8356—1.0802)	0.4316
VBAC	0.8238 (0.7444—0.9038)	0.0001	1.4378 (1.0432—1.9919)	0.0276
	July 2005—2010 (compare to 2002*) — Change of Rate from Period 2 to Period 3			
	95% CI	*p*		
Total C/S	1.0001 (0.9970—1.0032)	0.9471		
Primary C/S	0.9977 (0.9938—1.0016)	0.2427		
Repeated C/S	1.0032 (0.9982—1.0082)	0.2069		
VBAC	0.9755 (0.9624—0.9888)	0.0003		

2001* refers to the "period before HGBS"; 2002* refers to the "period after July 2002 HGBS —August 2005 HBSM".
HGBS = hospital global budget system; HBSM = hospital-based self-management.

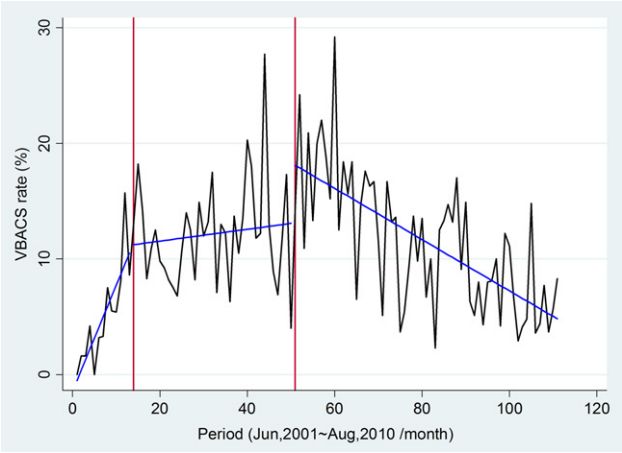

Figure 1 VBAC curve after the interrupted time series analysis.

Many factors could lead to an increased C/S rate, including maternal demographic factors, fetal variables, and intrapartum events. High C/S rates may be caused by the increase in the induction of labor, and continuous use of fetal electronic monitoring.[20] Klemetti (2010) found that the C/S was most common in educated, wealthy women in Eastern China, who received prenatal care and gave birth at high quality hospitals.[21]

In our study, the primary C/S rate was around 25% during the three periods, despite changes in management and incentive policies. This might be due to some cultural and practical factors, and the ever-accumulating medico-legal issues of the past decade. Because up to 70% of claims are based on abnormal cardiotocographs, the most common obstetric cause of dispute was attributable to intrapartum hypoxic encephalopathy due to fears of performing a late diagnosis of fetal distress when Cesarean delivery would have been appropriate.[22] Our findings have three clear policy implications, as it is now known that the total C/S rate and RCSR may not be affected by strategic policies and that VBAC rates may be lowered, at least temporarily, by using health policy and incentive strategies.

Ennen (2009) revealed that the risk factors for Cesarean delivery in women undergoing an indicated induction of labor include a low Bishop's score, high BMI, nulliparity, and diabetes.[23] However, Wilkinson (1998) found that four causes accounted for 82% of C/S operations in singleton pregnancies: (1) elective operation for breech presentations; (2) emergency prelabor operations due to fetal distress; (3) emergency sections during labor because of failure to progress; and (4) recommended RCSR.[24] In addition, physicians' clinical judgment and practice styles also might be influential in this regard. Several strategies could be used to reduce Cesarean section rates, including effective medical auditing of labor management;[25] departmental policy commitment, followed by goal setting and peer review;[26] and mandatory second opinions.[27] We also must consider the question of whether, "C/S rate could still become the quality indicator of obstetric health care and surrogate of financial incentives in the future" as stated by Cyr (2006).[28] He continues to state that, "an ideal Cesarean section rate cannot be defined outside a framework of individual value and assumptions. Because the Cesarean

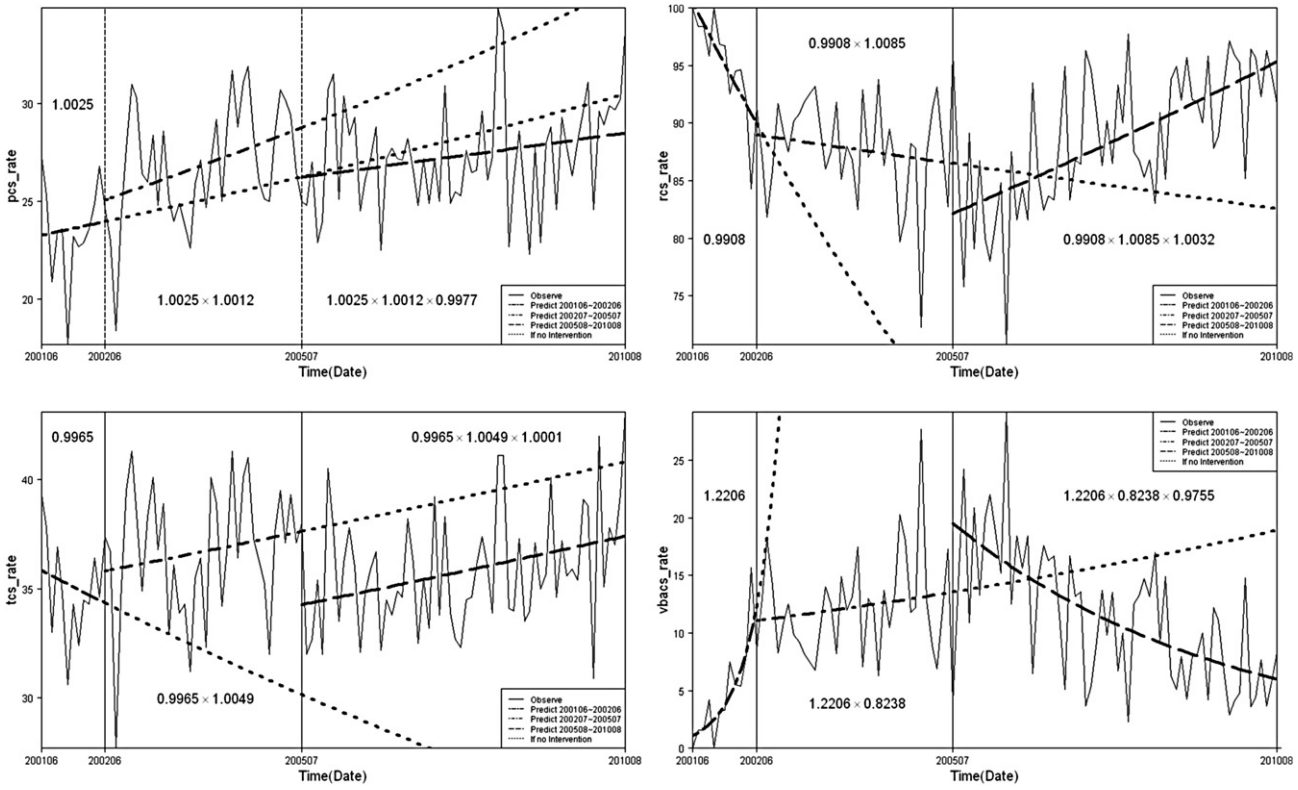

Figure 2 The trend (level and improvement of change in terms of rate ratio) of different patterns of Cesarean delivery during the three periods using poisson regression analysis.

rate is calculated *post hoc*, it is impossible to design a prospective trial comparing specific cesarean section rate."[28] Our study has several limitations. First, we did not have a control group. Second, we calculated monthly mean Cesarean section numbers, rather than assessing individual physician profiles. Third, for the second and third phases of the study period, we cannot separate each intervention or remove any of the composites to observe possible differences based on knowledge "diffusion" effects. Fourth, our estimates were based on a single hospital, and the results may not be sufficiently generalized to other health care settings. Finally, in this Poisson regression model and time series trend analysis, it is not easy to track individual physicians' decision-making behavior in performing a C/S. Furthermore, it was difficult to control for emergency versus nonemergency conditions, and we cannot correlate some intrapartum factors that might affect obstetricians' decision making. We would have to preclude elective Cesarean deliveries in order to calculate indicated Cesarean delivery rates.In conclusion, between 2001 and 2010, the long-term effect of the total C/S rate seemed to reach a plateau, and the immediate effect of VBAC rates revealed effects that are consistent with that of the initial health policy implementation. However, the long-term effect on the VBAC rate was still disputable, although this may be a result of the synergistic effects of the health policy implementation. This result may imply the possibility of some potential risks existing within VBAC procedures and process. The total Cesarean delivery rates have not changed significantly; they are still around 36%.

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